

are examined it is found that the leaf-scars of *Cyclostigma* contain three cicatricules similar to those of *Bothrodendron*.

EXPLANATION OF PLATE IV.

- Fig. 1.* *Sigillaria discophora*, König, sp., nat. size. 1 *a.* Leaf-scar enlarged and showing the three cicatricules. *Loc.* Shale over Whistler Seam, Bonnington Pit, Kilmarnock. Communicated by the Rev. David Landsborough. *Hor.* Lower Coal-measures.
- Figs. 2-4.* *Bothrodendron Wukianum*, Kidston, n. sp. 2. *Loc.* Little Whickhope Burn, near first branch above Cross Sike, Northumberland; nat. size. 2 *a.* Leaf-scar, enlarged. *Hor.* Calciferous Sandstone Series. Communicated by Mr. H. Miller, F.R.S.E. 3. *Loc.* Railway-cutting between Kates Mill and Boags Mill, Water of Leith, Midlothian. *Hor.* Calciferous Sandstone Series. Collected by Mr. J. Bennie. Nat. size. Specimen in the Collection of the Geol. Survey of Scotland. 3 *a.* Leaf-scar, enlarged. 4. *Loc.* Shore, Wardie, Midlothian. *Hor.* Calciferous Sandstone Series. Nat. size. Collected by Dr. J. M. Macfarlane. 4 *a.* Leaf-scar, enlarged.
- Figs. 5-6.* *Bothrodendron minutifolium*, Boulay, sp. 5. *Loc.* Shale over Whistler Seam, Bonnington Pit, Kilmarnock. *Hor.* Lower Coal-measures. Nat. size. Communicated by the Rev. D. Landsborough. 5 *a.* Leaf-scar, enlarged. 5 *b.* Subepidermal cicatricules, enlarged. 6. *Loc.* Shale over "Barnsley Thick Coal," Monkton Main Colliery, near Barnsley, Yorkshire. Middle Coal-measures. Collected by Mr. W. Hemingway. Nat. size.

X.—On a new Genus of *Macrura* (*Ophthalmeryon transitionalis*). By C. SPENCE BATE, F.R.S.

[Plate IX.]

SOME short time since a small and much battered Crustacean was sent to me by Mr. George Merritt, with the request that I would inform him what it was. It proved to be new, and I propose to call it *Ophthalmeryon transitionalis*.

Unfortunately the specimen had been swallowed by a dolphin, and had therefore been affected somewhat by the gastric juices of the fish's stomach. Having been preserved in a dry condition, it was consequently very brittle and not in a state fit for examination. I therefore placed it for several weeks in a preparation of glycerine &c. to preserve and soften its texture before subjecting it to the risk of observation.

Its general appearance is that of a small Brachyurous Crustacean somewhat allied in form to *Ebalia* in its dorsal aspect. The carapace is about 9 millim. long and as many

broad across the cardiac and branchial regions; but this cannot be clearly defined, as the laterally projecting tubercles are somewhat damaged either by the action of the gastric juices during the incarceration of the specimen in the dolphin's stomach or from manipulation afterwards in its dried condition.

The anterior portion or frontal region is narrow and depressed, the central line being produced anteriorly into a small rostrum, on each side of which is a slight concavity or hollow space for the greater freedom of the movements of the ophthalmopoda and antennæ. The antero-lateral angle is anteriorly projected downwards as a strong point or process that is slightly curved, and on the upper or dorsal surface is produced into a strong process or horn which is projected upwards and slightly curved backwards at an elevation higher than the median line of the gastric region, which lies as a plane between the two lateral prominences and separated from them by a deep and narrow fissure. The cardiac region is surmounted by two large tubercles that are separated from each other longitudinally in the median line. Both lateral prominences are circular at base, tipped with small tubercles, and mammiform in appearance; posterior to these on each side is a row of three tubercles continuous to the posterior margin of the carapace. On the outer or lateral side the branchial region is produced into large protuberances, the surfaces of which are not clearly distinguishable, from external injury; the lateral walls are curved inwards on the lower surface, leaving only a narrow space between them, in which lies the posterior portion of the pleon and the rhipidura or tail-fan.

The pleon is narrow, smooth, and laterally compressed; the telson tapers posteriorly and terminates in two processes, one at each postero-lateral angle, and on its inner margin bears a series of six sharp teeth which gradually increase in length, and the lobe is tipped with a smooth spine 0·5 millim. long. The telson is also armed on each side with three small spines—one near the middle, a second halfway between the first and the posterior extremity, and the third rather nearer than halfway between the preceding and the posterior extremity.

The carapace is about 9 millim. long.

The pleon is about 6 millim.

The telson is about 2 millim.

The ophthalmopoda (Pl. IX. fig. 1, *a*) are long and broad, the ophthalmus being large, pear-shaped, and projected upon a slender biarticulate peduncle.

The first pair of antennæ (*b*) are short, the first joint is

broad and furnished on the outer side with a wide and sharp-pointed stylocerite, which is of great tenuity and free from cilia, whereas the inner side of the shaft of the appendage is fringed with a few simple cilia. The second joint is about half the length of the first and more free from cilia, there being only three or four on the inner margin. The third joint is very short, but nearly as broad as the preceding, and is furnished with a bundle of long hairs on the inner distal angle; it supports two short flagella, of which the outer is the shorter, and carries towards its distal extremity a series of membranous cilia. The inner flagellum is subequally robust with the outer one, but free from cilia of any kind.

The second pair of antennæ (*c*) are furnished with a long ovate scaphocerite, the outer margin of which is rigid, and at the distal extremity, where a small tooth generally exists, the rudiment only of one is seen; the squamose portion is of extreme tenuity and projects distally beyond the rigid margin, and is fringed with numerous fine ciliated hairs; on the inner side of the scaphocerite is another joint that is short and robust, from the distal extremity of which projects a long and slender flagellum that is somewhat rigid and gradually tapers to its extremity.

The mandible (*d*) consists of a smooth and pointed psalidostoma which is in continuity with the slightly projecting molar process, having on the anterior margin a short three-jointed synaliphod, the two distal joints of which are fringed with a few strong hairs.

The first siagonopod (*e*) is three-jointed and three-branched: the first joint is short, robust, and produced on the inner side into a large flattened process fringed with hairs: the second joint is narrower than the first, but not much longer; it has its distal extremity, which is broad and oblique, fringed with short, stiff, tooth-like spines; on its outer margin a small unarticulate branch exists, which is adorned with two slender and rather long hairs at the distal extremity.

The second siagonopod (*f*) is of five branches, all of which are foliaceous and of extreme tenuity, and are unbranched, excepting the second, which is biramose; the fourth branch is shorter than the others, narrow, and sharp-pointed; while the fifth or outer one is broad and long, being equal in size to the three on the inner side; it is also pointed anteriorly and broad posteriorly, and represents homologically the mastigobranchial appendage, just as the fourth joint represents the continuation of the theoretical limb. The first three or inner branches are

fringed with long hairs at the broad and leaf-like extremity ; the fourth is fringed with a few hairs on the inner side and apex only ; whereas the fifth or posterior branch is fringed with cilia all round, the hairs being centrifugally arranged with their extremities slightly curved towards the anterior point.

The third siagonopod (*g*) is six-jointed and biramose. The first and second joints are produced on the inner side in the form of two large foliaceous plates, the margins being fringed with a series of fasciculi of long and stiff hairs ; the plate of the second joint is produced beyond its distal extremity or outer portion, from which it is distinctly separated for about half its length, and the distal extremity of the joint has the inner angle furnished with a bundle of long hairs.

Succeeding these, four other joints are successively produced, being subequal in length, of which the penultimate is the longest and the last the shortest, each gradually narrowing in diameter and tapering to the distal extremity, and each furnished with a fasciculus of hairs at the inner distal extremity ; on the outer side a second branch, a true basecephysis, projects, the base of which consists of a long and robust joint furnished on the outer margin with a few simple hairs and continued at the extremity into a multiarticulate ramus, which is nearly smooth or only sparsely furnished with hairs.

The first pair of gnathopoda (*h*) are pediform and biramose, the basecephysis being well developed and reaching rather beyond the extremity of the dactylos. The coxal joint is short and broad, and supports on its anterior and outer wall a small podobranchial plume. The basal joint is long and stout, the anterior margin is longitudinally concave, smooth, and produced somewhat beyond its articulation with the ischium, whereas the posterior margin is convex and adorned with three rather large fasciculi of short, stiff, and simple hairs. The ischium is a little shorter than the basis and about half its diameter in breadth ; it is smooth on the upper or anterior surface and thickly studded with short, simple, and rather stiff hairs on the posterior margin. The meros is shorter than the ischium, somewhat pear-shaped in form, having the narrow portion towards the ischium and the larger towards the carpus ; the upper or anterior margin is smooth and convex, while the lower is smooth and waved, being concave towards the ischium and convex towards the carpus ; the lobe and distal margin are fringed with a few long simple hairs. The carpus is subequal in length with the ischium, cylindrical

in form, the distal margin as well as the upper and lower angles being furnished with long hairs. The propodos is rather shorter than the carpus, conical in form, and furnished with numerous stiff hairs that have their surface thickly armed with short sharp-pointed teeth. The dactylos is long, slender, and hair-like, and only differing from those hairs with which it mingles by being a little more robust. The basephysis is long, slender, and multiarticulate, the basal joint being robust and cylindrical.

The second pair of gnathopoda (*i*) are about one third longer than the first; the coxal joint is stout, short, and supports an efficient but not long podobranchial plume. The basal joint is large and strong and produced beyond the ischial articulation to form a strong process, with which articulates the multiarticulate basephysis, which resembles that of the first pair excepting in its relative length. The ischium is cylindrical, having the anterior margin smooth and the posterior fringed with a few simple hairs. The meros is longer and not quite so robust as the ischium, and fringed on the sides and posterior margin with a few simple hairs. The carpus is long and slender, having the distal extremity somewhat stouter than the proximal, and the lower distal portion is furnished with a few hairs. The dactylos is slender and slightly tapering to an extremity that is armed with a few hairs, the more important of which are fringed with a few cilia.

The first pair of pereiopoda (*n*) are short, feeble, and chelate; the coxa is short and supports an elongate podobranchia and a short appendage, which I take to be the rudimentary mastigobranchia. The basis is long and stout, rather broader at the distal than the proximal extremity, and supports a long and slender multiarticulate basephysis that reaches considerably beyond the extremity of the dactylos. The ischium is short, being scarcely longer than it is broad, and fringed on the posterior margin with a few minute hairs. The meros is about three times as long as the ischium and similarly fringed on the posterior margin and furnished with one long ciliated hair on the anterior distal angle. The carpus is slightly longer than the meros and furnished with one ciliated hair on the posterior margin just behind the distal angle and another on the anterior distal angle; the propodos increases gradually to the level of the dactyloid joint, where it is broadest; the pollex is produced as a simple pointed process, slightly swollen previously to its reaching the apex, where it is furnished with two small spines, and two others a little posteriorly on the outer margin; two or three long and ciliated

hairs stand at the dactyloid articulation and reach beyond the extremity of the dactylos, which is formed like the pollex and tipped with three straight, stiff, and ciliated hairs.

The second, third, and fourth pairs resemble the first, being perhaps rather more slender; and the fifth pair (*o*) are still shorter and differ from the preceding chiefly in terminating in a non-chelate extremity free from hairs, excepting a simple one on the dactylos, a ciliated one on the carpus, and another on the meros.

The pleopoda are short and feeble and have not been properly examined.

The branchial plumes are numerous, but in consequence of having been preserved in a desiccated condition they are not capable of being carefully noted; but there appears to be a series of arthrobranchiæ and pleurobranchiæ, which probably may be arranged as follows:—

Pleurobranchiæ . . . . .		1	1	1	1		
Arthrobranchiæ . . . . .		2	2	2	2		
Podobranchiæ . . . . .	1	1	1	1	1	1	
Mastigobranchiæ . . . . .		.	.	<i>r</i>	<i>r</i>	<i>r</i>	<i>r</i>
		<i>h</i>	<i>i</i>	<i>k</i>	<i>l</i>	<i>m</i>	<i>n</i> <i>o</i>

	millim.
Length of the animal from the rostrum to the posterior extremity of the carapace . . . . .	9
Length of the pleon . . . . .	6
Breadth of carapace . . . . .	about 6
Length of ophthalmopod . . . . .	
"    "    first antenna . . . . .	4
"    "    second antenna to extremity of scaphocerite. . . . .	4
"    "    flagellum, broken? . . . . .	9
"    "    mandible, dissected out . . . . .	5
"    "    synaphipod . . . . .	2
"    "    first gnathopod . . . . .	6
"    "    second " . . . . .	9
"    "    third pereiopod . . . . .	5
"    "    "    "    basephysis of . . . . .	5
"    "    "    "    fifth " . . . . .	3
"    "    "    "    "    "    basephysis of . . . . .	3

The general aspect of the animal to casual observation is more that of a Crustacean belonging to the Brachyura than to one of the Macrurous division.

The broad and quadrate character of the carapace and the narrow and folded condition of the pleon are features of the Brachyura type; but, on the other hand, the long and sweeping branches (ecephyses) attached to the ambulatory legs, which are themselves apparently too short and feeble to be of much use, and the imperfect condition of the chelate appendages,

while demonstrating their powerless condition as prehensile organs, seem to argue that the animal is related to the lower type of the long-tailed forms, more especially to that group which is denominated Schizopods, if Professor Sars's definition of the presence of long and sweeping appendages be a primary feature of their character. But this point I have, I think, successfully shown, in the Report of the 'Challenger' *Macrura*, to be a feature that is common with others and that it is not a condition peculiar to any group.

If we examine the animal now before us in detail we shall find that the pereopoda bear a characteristic resemblance to those found in the Eryonidæ, but differ from them in the retention of the branches, features consistent with immature forms, but rarely present in the adult condition and never previously found among the Eryonidæ, although there is nothing inconsistent with their presence in that family.

The Eryonidæ, looked at both in their fossil and recent condition, contain many forms which vary considerably in detail from each other and are more than specifically distinct.

The fossil species which has been figured by Desmarest, and on which the family is founded (*E. Cuvieri*), possesses the remains of a pair of biarticulate appendages which from position



*Eryon Cuvieri*, after Desmarest, with ophthalmi added in dotted outline.

and form can only be accepted as the pedicular bases of the ophthalmopoda; and I believe in this sense they were understood by Dr. Willemoes-Suhm when he wrote in his notes,

which have been transferred into the 'Challenger' Report on the Crustacea *Macrura*, p. 112, "*Eryon* was probably not blind, for the eye-stalks have been found in several specimens."

On the other hand, Dr. Woodward, of the British Museum, who as a geologist has given much attention to this group of Crustacea, says that the eye "has never been positively determined," and he has restored a specimen with these organs present. I have never seen a specimen, neither, I believe, has any ever been found in which the ophthalmus is undoubtedly preserved.

In *Eryon Brodiei* the orbit is preserved and shown to be moderately deep, and the latero-anterior angle is well advanced. It is the same, but in a rather less marked condition, in *Eryon wilmcotensis*, while in *Eryon Moorei* and *Eryon crassicheles* both orbital notch and antennal angle are reduced to a minimum.

In *Archæastacus Willemæsi* the latero-anterior angle of the carapace is so well developed as to produce a well-formed but shallow orbital notch in the frontal margin of the carapace in position corresponding with those found in the recent genera, but less excavate and characteristic. In this unique fossil the ophthalmopoda are not preserved, but the form of the orbit is suggestive of the existence of such an organ.

From the Upper Lias of Calvados M. Morière described\* a species under the name of *Eryon calvadosii*, in which the orbits for the reception of the organs of vision are well preserved, and the specimen has the appearance of having had the ophthalmopoda broken off and retained in the lost matrix.

If we now turn to the specimen before us we find that the organs of vision are present in a peculiar and well-developed form. The ophthalmus is projected upon an elongated and slender stalk, and is capable of being bent considerably on itself; and both articulations possess considerable mobile power, so much so that the ophthalmus is capable of being bent beneath the frontal margin and hidden from view. But although it is not visible when inspected on the dorsal surface, it is so placed that it is capable of seeing through the curved or hollow space that exists on the outer side beneath the antero-frontal angle of the carapace; but when the animal wills it is capable of being projected forwards, and when advanced the peduncles may be seen very much like those shown in *Eryon Cuvieri*, as figured by Desmarest and shown in our woodcut on page 73.

The first pair of antennæ exhibit a peculiarity at variance

\* Bull. Soc. Linn. de Normand. sér. 3, tom. vii. pp. 1-10, pls. i.-iii. (1853).



with all the group, and present a character in the presence of the stylocerite that distinguishes them from those that belong to the Trichobranchiata, and makes me much regret that the previously desiccated condition precludes a satisfactory examination of the branchial structure. In most of the recent forms allied to Eryonidæ the inner margin of the first joint of the peduncle of the antenna is laterally produced into a broad and thin plate which is projected upward in the median line in consequence of its meeting a similar projecting plate belonging to the opposite side. In a few species it is reduced in importance to little more than a big tooth; but it is absent generally from all other genera of the Trichobranchiata. On the outer side there is no stylocerite such as we find conspicuous in all the Phyllobranchiate *Macrura* and exists in a modified form in the Dendrobranchiata. In the species now under consideration it is prominent, well defined, and of considerable tenacity, and therefore in this character approaches that of the Phyllobranchiata.

The second pair of antennæ have the flagellum broken; but from its proportions it may be assumed to have been about the length of the carapace or perhaps a little longer; the scaphocerite is leaf-like and hairy, and has the margin on the outer side rigid and produced to the rudiment of a tooth, while the inner side is fringed with fine ciliated hairs, the whole structure bearing a membranous character of extreme tenacity.

The mandibles (*d*) are powerful organs, smooth along the psalisiform or cutting margin, with the molar protuberance short and robust, and on the outer surface there exists a three-jointed synnhipod or appendage, which differs from the typical forms of the recent Eryonidæ in which there are only two joints, but corresponds with most other families of the normal Trichobranchiata.

The first pair of siagonopoda (*e*) or maxillæ bear a resemblance to those of *Willemasia*, but differ in the possession of a small joint on the outer side of the chief branch.

The second pair (*f*) resemble more nearly those of the family Astacidæ and differ chiefly in not having the mastigobranchial plates posteriorly produced, but rounded off short.

The third pair (*g*) are in a more advanced condition than I have found in any of the typical *Macrura* and have the primary branch six-jointed and support a well-developed multiarticulate basephysis.

The first pair of gnathopoda (*h*) are well developed and pediform, having the basis very long and furnished with a

multiarticulate basephysis that reaches beyond the distal extremity of the dactylos, which is sharp-pointed, slightly curved, and imbedded among a number of fringed stiff hairs; a small branchial plume stands on the outer frontal surface of the coxa.

The second pair (*i*) resemble the first, but have the joints longer and more slender and furnished with hairs that are more slender and fringed with delicate cilia instead of short spines. The basephysis, although absolutely longer, is relatively shorter than the limb to which it is attached and articulates with the basis at the extremity of a strong process, which is an unusual feature.

The four anterior pairs of pereiopoda (*n*) are similar in form and vary little in size; they are all chelate, but inefficiently so; the pollex and dactylos being straight and pointed appear to be organs ill adapted for the purpose of holding as by a finger and thumb; each joint is furnished with one or more long, straight, and ciliated hairs. The basis is long and robust, being with the coxa nearly equal in length to the other five joints; at the anterior and distal extremity is a multiarticulate basephysis which reaches considerably beyond the extremity of the dactylos and is fringed on the posterior margin only with numerous ciliated hairs. The coxa supports a long podobranchia and a small mastigobranchial plate of a rudimentary character.

The fifth pair (*o*) are shorter, being little more than half the length of the preceding; they terminate in an obtuse-pointed dactylos, and have an ephysis attached to the basal joint.

The pleopoda are biramose, with subequal branches, and weak in their development. The posterior pair form the lateral plates of the rhipidura or tail-fan; but the plates are about one fourth shorter than the telson. The outer plate is broader than the inner, which is narrow, pointed, and a little shorter than the outer, which appears to be without a diæresis.

#### EXPLANATION OF PLATE IX.

*Fig. 1.* *Ophthalmeryon transitionalis*, seen dorsally.

*Fig. 2.* The same, viewed ventrally.

*Fig. 3.* The same, seen laterally.

*a.* Ophthalmopod.

*b.* First antenna.

*c.* Second „

*d.* Mandible.

*e.* First siagonopod.

*f.* Second „

*g.* Third „

*h.* First gnathopod.

*i.* Second „

*n.* First pereiopod.

*o.* Fifth „

*v.* Sixth pleopod.

*z.* Telson.